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PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) AUTOMATIC DOOR CLOSERS

(71) We, DORKEN & MANKEN KG, a German company of 42—48 Breckerfelder Strasse, Ennepetal-Voerde, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to automatic door closers, in particular a door closer suitable for use as a built-in unit.

A door closer has been proposed in which a shaft rotated by movement of a door to which it is connected carries an annular flange on which is mounted a crank pin and which has a trough-shaped recess at its edge, into which drops a spring-loaded pressure roller when the open position of the door is reached, the pressure roller checking the door closer in the open position so that the door closing movement must be initiated by an external force which releases the check device, that is, which acts in the direction of closing of the door. The crank pin moves a multi-member linkage which is loaded by a spring forming the energy storage means to move the door towards the closed position and which also controls the piston of a hydraulic piston-cylinder damping assembly. In such a door closer the check device is used to retain the door in an open position.

In some automatic door closers, the damping device is intended to limit the speed of the door closing movement as the door closes under the action of the spring. Generally the damping device is only effective over a portion adjacent the closed position of the total range of movement through which the door moves in normal use. Different retarding actions are obtained within this portion of the range of door movement by suitable arrangement of fluid transfer channels and the like, which may be adjustable. However only such portions of the total range of door movement which are accessible to an effective damping or retarding action can be controlled as described above, so that apart from such portions the door movement is unrestricted.

According to the present invention there is provided an automatic door closer including a housing, a rotary shaft carried in the housing and capable of being connected to a door on which the door closer is to be used, spring means operatively connected to the shaft for moving the door towards a closed position, damping means operatively connected to the shaft to damp the door closing movement, and means connected to the shaft and having a track to actuate a hydraulic piston-cylinder assembly to check the movement of the door over predetermined angles of door movement.

Two embodiments of an automatic door closer according to the present invention will now be described by way of example with reference to the accompanying drawing, in which:

Figure 1 shows a cross section taken horizontally through part of a first embodiment of a floor-mounted door closer for a door opening in one direction,

Figure 2 shows a cross section similar to that shown in Figure 1, with the door in a different position from that shown in Figure 1,

Figure 3 shows a partial cross section taken along the line III—III of Figure 1,

Figure 4 shows a partial cross section taken along the line IV—IV of Figure 2,

Figure 5 shows a view similar to Figure 1 of a second embodiment,

Figure 6 shows a similar view to Figure 5, with the door in a different position.

Referring firstly to Figure 1, the first embodiment of the door closer which in use may be set into the floor over which the door (not shown) moves, comprises a housing 10 in which there is rotatably mounted a shaft 11 connected to the door. Mounted eccentrically on the shaft 11 is a crank pin 12 which, by way of a linkage comprising two connected members 13, 14, controls a lever 16 which is pivotable in the housing 10 about a pin 15. Connected side by side

[Price 5s. 0d. (25p)]

to the lever 16 are a traction spring 17 which forms the energy storage means to return the door from an opened towards a closed position, and an extension or lug 18 of a damping piston 19 which, with a cylinder 20, forms a hydraulic damping device. As shown in Figures 1 and 2, and also in Figures 5 and 6, at the level of the crank pin 12 the shaft 11 is partly cut away to form a face 21 against which the member 13 abuts at large angles of door opening, and also to provide sufficient space for the member 14 and its connection to the member 13. In the embodiment illustrated, the member 13 can have one arm and the member 14 can have two arms in order to engage from the outside over the lever 16 which also has two arms, between which are fitted the lug 18 of the piston 19 and a holder 22 for the spring 17.

In operation of the above described door closer, starting from a door closed position which is not shown, as the shaft 11 is turned in the clockwise direction, the initially extended linkage 13, 14 causes the lever 16 to be pivoted about the pin 15 in the anti-clockwise direction so that the spring 17 is put under tension and the piston 19 is drawn outwardly of the cylinder 20 with the result that the working chamber formed between the closed end of the cylinder 20 and the associated end face of the piston 19 increases in volume. As the door continues to open, the member 13 comes to lie against the face 21 of the shaft 11, that is, the linkage 13, 14 folds in and the lever 16 is moved further in the anti-clockwise direction. When the door is released from an opened position, the spring 17 returns the lever 16 in the clockwise direction and the shaft 11 is rotated in the anti-clockwise direction by way of the linkage 13, 14 so that the door is moved towards the closed position. The speed of closing is restricted by the damping device 19, 20, at least in the range close to the closed position.

Formed in the housing 10 is a cylindrical bore 25 in which a piston 26 is slidable to act as a hydraulic check device. The piston 26 carries at its forward end in two mounting plates 27 a pivot pin 28 on which a pressure roller 29 is rotatable. The forward end of the piston 26 includes a fluid transfer passage 31 which is blocked in one direction of flow by a movable ball 30 which acts as a valve member. Movement of the ball 30 is limited by a cap-shaped apertured insert 32 while the piston 26 is held in an operative position by a precompressed spring 33 which presses the piston 26 forwards in the bore 25. At its other end, the spring 33 bears against a removable plug 34 which closes the bore 25. The spring 33 only acts to urge the piston 26 into a forward position and is in no way operative directly to check the door movement.

Two fluid transfer passages 36 and 37 open into the bore 25, near the plug 34. As shown in Figure 3, the passage 36 leads to an adjustable restrictor valve member 38 and the passage 37 leads to an adjustable pressure relief valve assembly 39 which serves to prevent damage to the door closer or door mountings, which might be caused by abnormally high forces acting on the door.

Referring now to Figure 4, a pin 40 carried in a bore (not referenced) in the housing 10 projects into the bore 25, the pin 40 engaging into a longitudinal groove 41 in the piston 26 to act as a guide to prevent the piston 26 rotating and also to restrict its stroke so that it is retained within the bore 25.

Referring again to Figures 1 and 2, the pressure roller 29 co-operates with a part 45 of the member 13, which part has an actuating track for actuating the hydraulic check device. This part 45 is defined by a relatively sharply angled lifting face 46, that is, such that when the roller 29 lies against the face 46, a small angular movement of the part 45 produces a relatively large movement of the piston 26, and a less sharply angled lifting face 47. A track portion 48 which extends substantially concentrically to the rotary axis of the shaft 11 joins the two faces 46 and 47.

The position shown in Figure 1 of the parts of the door closer corresponds to an angle of door opening of about 100°, while the position shown in Figure 2 corresponds to an angle of door opening of about 75°. Because of the shape of the actuation track, the embodiment shown in Figures 1 and 2 gives a temporary delay or check action as the door closes automatically under the action of the spring 17. During the closing movement of the door, at an angle of door opening corresponding to about 100°, that is, the position shown in Figure 1, the face 46 of the actuating track comes to lie against the presure roller 29 of the piston 26 which is then in its forward limit position.

For the door to be closed further by the energy stored in the spring 17, the piston 26 must be urged back into the bore 25 by means of the pressure roller 29 co-operating with the lifting face 46, in which case some of the working fluid contained in the working chamber defined by the bore 25 and the cylinder 26, must be expelled from that chamber through the restrictor valve assembly 36, 38. Movement of the door towards the closing position is therefore checked in dependence on the cross-section of the bore 25, the restriction action of the restrictor valve assembly 36, 38 and the angle of the lifting face 46 which controls the speed of movement of the piston 26, although there is no

possibility of the door movement being completely blocked as the hydraulic resistance also decreases with the door closing speed. Only when the pressure roller 29 reaches the end of the lifting face 46 as shown in Figure 2 does the hydraulic check device become inactive, due to the pressure roller 29 co-operating with the concentric track portion 48, so that further closing movement of the door can now take place at the normal speed dictated by the spring 17 and the damping device 19, 20, that is, relatively quickly. If, as this happens, the pressure roller 29 comes into co-operation with the face 47 of the actuating track, which allows the piston 26 to advance in the bore 25 to a greater or lesser degree, fluid flows through the passage 31 into the working chamber so that the check device could exert a retarding action upon the door being opened again. If the track portion 48 which is adjacent the lifting face 46 and which extends concentrically to the rotary axis of the shaft 11 is of such a size that the piston remains in its retracted position shown in Figure 2, there would not be any such retarding action upon opening of the door.

The construction shown in Figures 1 and 2 can be used in order for the automatic closing of the door to be considerably delayed over a relatively small angle of door movement when the door is relatively wide open so that, when the door is open, it remains open to allow free passage through the doorway for a limited period, for example 15 seconds, whereupon it closes automatically and relatively rapidly.

The embodiment shown in Figures 5 and 6 substantially corresponds to that shown in Figures 1 to 4, with the exception of the shape of the actuating track formed by a part 50 and mainly comprising a lifting face 51. This embodiment is mainly intended to produce a retarding or check action upon the door being opened to a certain angle, as determined by the shape of the actuating track. When the angle of door opening of about 75° is reached as shown in Figure 5, the lifting face 51 comes to lie against the pressure roller 29 of the piston 26 and upon further opening of the door, presses the piston 26 into the bore 25 so that a part of the working fluid contained in the working chamber is forced out, being throttled as it escapes by way of the restrictor valve assembly 36, 38. When an angle of door opening of about 90° as shown in Figure 6 is reached, the action of the check device is terminated. Upon further opening of the door, owing to the shape illustrated of the rear face of the part 50, the piston 26 would again be able to advance under the action of its spring 33 from the retracted position shown in Figure 6, which would result in the door being initially checked upon release from such a further open position. However the embodiment shown in Figures 5 and 6 may be intended for a door assembly in which the maximum angle of door opening is from 90 to 100°. Obviously it would also be possible to provide a check action on the door opening movement in the range of door movement from 75 to 90°, as shown in Figures 5 and 6, and still permit a larger angle of door opening without the door closing movement being checked when the door is released from the wider open position by the actuating track including a portion, adjoining the peak of the lifting face 51, which is concentric with the rotary axis of the shaft 11 so that the piston 26 is held in its retracted position up to the maximum angle of door opening.

As already mentioned, the invention is not limited to the embodiments described and illustrated. Thus for example, the piston 26 may be carried in a bore formed in a part produced separately from, and secured in use to, the housing 10. It is also possible for the piston to be secured to the housing, with the cylinder slidably carried on the piston. In addition to checking the door opening movement or the door closing movement, the check device may also be designed to check both movements, the shape of the actuating track determining the part or parts of the range of door movement over which the check device is active. Instead of being on a member of a linkage, the actuating track could also be provided on another movable part of the door closer which is connected to the shaft, for example on a plate which is rigidly connected to the shaft.

WHAT WE CLAIM IS:—

1. An automatic door closer including a housing, a rotary shaft carried in the housing and capable of being connected to a door on which the door closer is to be used, spring means operatively connected to the shaft for moving the door towards a closed position, damping means operatively connected to the shaft to damp the door closing movement, and means connected to the shaft and having a track to actuate a hydraulic piston-cylinder assembly to check the movement of the door over predetermined angles of door movement.

2. A door closer according to claim 1 wherein said hydraulic piston-cylinder assembly includes a piston spring-loaded in a cylinder into operative engagement with said actuating track.

3. A door closer according to claim 2 wherein said piston is non-rotatable within the cylinder and carries a roller arranged to co-operate with said actuating track.

4. A door closer according to claim 1, claim 2 or claim 3, wherein said cylinder comprises a bore formed in said housing.

5. A door closer according to claim 1,

claim 2 or claim 3, wherein said piston-cylinder assembly is in the form of a removable insert in said housing.

6. A door closer according to claim 1 wherein the piston of said piston-cylinder assembly is fixed in the housing and the cylinder is slidable on the piston for operative engagement with said actuating track.

7. A door closer according to any one of the preceding claims wherein said actuating track is disposed on a first member of a linkage which connects said shaft to a lever engaged by said spring means and by said damping means, said first member being pivotally eccentrically connected to said shaft.

8. A door closer according to any one of the preceding claims wherein the shape of said actuating track is such as to produce a check in movement of the door from an opened towards a closed position.

9. A door closer according to any one of claims 1 to 7 wherein the shape of said actuating track is such as to produce a check in movement of the door towards an opened position.

10. A door closer according to claim 2 or any claim dependent thereon, wherein said piston carries a non-return valve operative to prevent fluid flowing out of the working chamber of the piston-cylinder assembly, and two passages are in communication with said working chamber, one passage incorporating a restrictor valve and the other passage incorporating a pressure-relief valve.

11. A door closer according to claim 10 wherein either one or both of said valves is or are adjustable.

12. An automatic door closer substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawing.

13. An automatic door closer substantially as hereinbefore described with reference to Figures 3 to 6 of the accompanying drawing.

14. In a door assembly, an automatic door closer according to any one of the preceding claims.

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1220007 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG.1

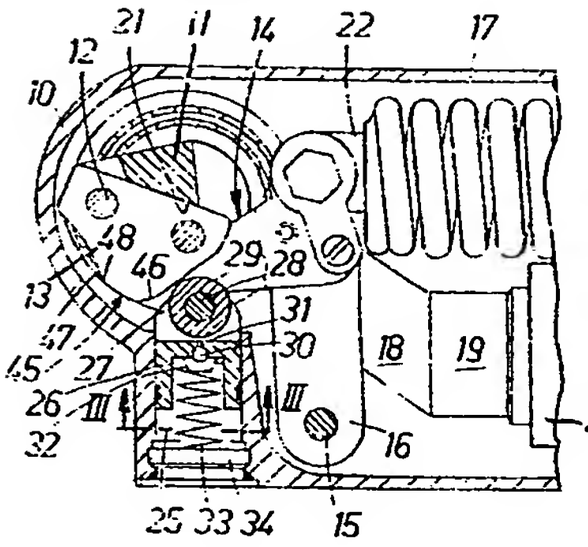

FIG.2

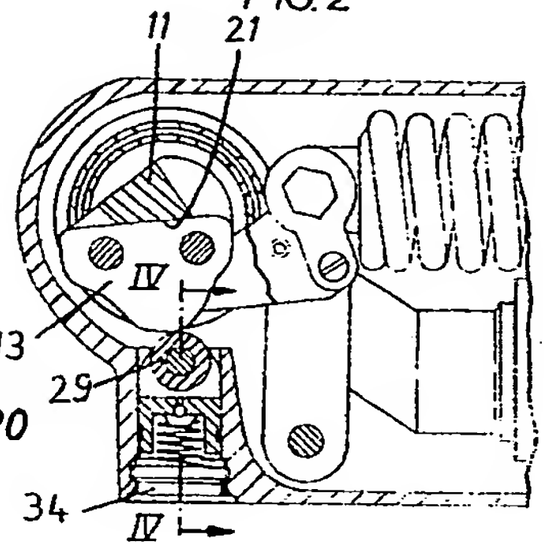

FIG.3

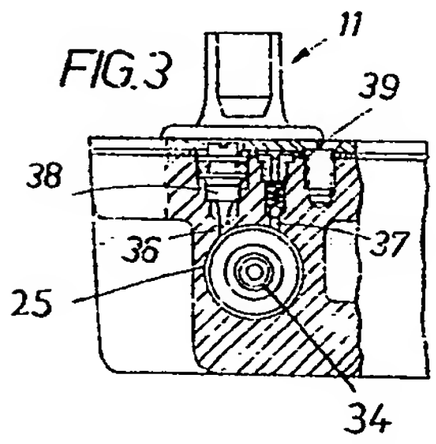

FIG.5

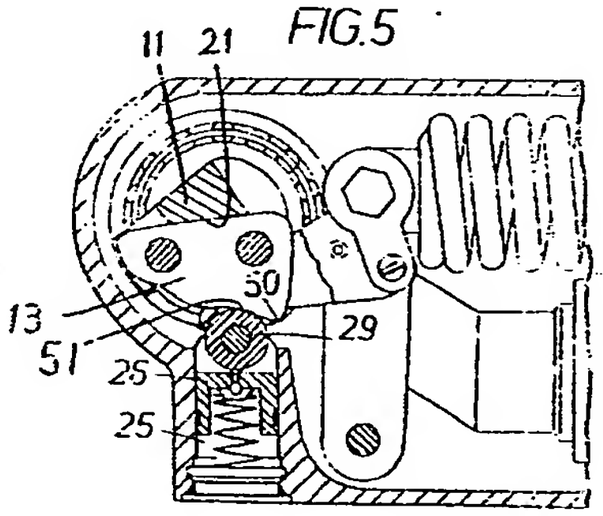

FIG.6

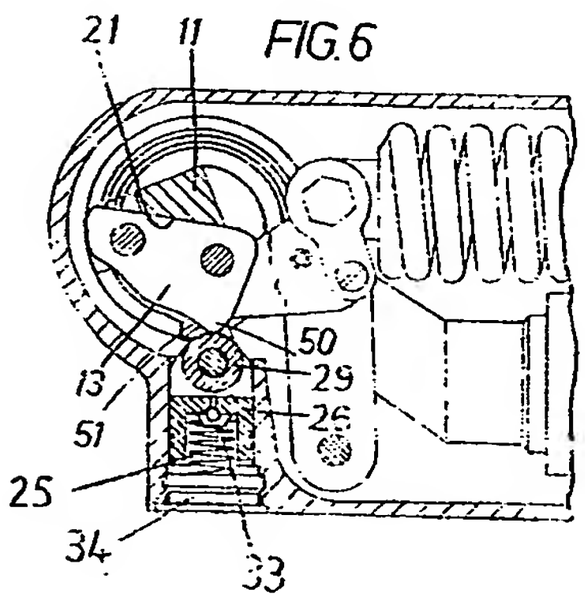

FIG.4